ASSOCIATIONS AMONG FEEDING BEHAVIORS AND EARLY PHYSICAL AND HEALTH OUTCOMES DURING INFANCY

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Importance of Early Feeding

- Infant feeding practices are associated with:
  - Nutrition
  - Infection
  - Obesity
  - Illness
- Examples of infant foods:
  - Breast milk
  - Formula
  - Cow's milk
  - Solid and finger foods

American Association of Pediatrics (AAP) Feeding Recommendations

- Exclusive breastfeeding for the first 6 months of life without any form of supplementation
- Children who are not breastfed or are being weaned before 6 months of age, should be fed formula
- Delay introduction of cow's milk until 12 months
- Delay the introduction of solid foods (e.g., jarred baby food) and finger foods (cheerios, biscuits) until 6 months

2002 Feeding Infants and Toddlers Study (FITS)

- BREASTFEEDING: Breastfeeding initiation rate was 76%, with 30% at age 6 months
- FORMULA: 90% of formula was iron fortified
- SOLID/FINGER FOOD: for 33% of infants the timing of introduction of complementary feeding before 4-6 months
- COW'S MILK: 33% of infants introduced to cow's milk before age 12 months

(Hendricks, Briefel, Nocak, & Ziegler, 2006).

Limitations in the Literature

- Is it type of feeding or the environment it occurs in that matters for health?
  - A variety of variables influence mothers' infant feeding practices
  - These influences may also be associated with child health and are therefore spurious variables
- Do the combinations of foods matter?
  - Literature has not addressed whether some foods are better or worse in combination with other foods

The ECLS-B

- The ECLS-B is a good data set to address these limitations:
  - Feeding information collected in addition to usual initiation and duration of breastfeeding
  - Aspects of child health and physical development reported by parents and measured
  - Measured a host of potential spurious variables such as child, family, and home characteristics to control for
  - Nationally representative
  - Longitudinal data on child health outcomes

Research Questions

1) What percentage of children were introduced breast milk, infant formula, finger/solid (s/f) food, and cow's milk during the first six months of life?

2) In what combination were these foods most commonly fed in the first six months?

3) Are feeding combinations associated with child health at 2 years (overall health rating, BMI, asthma, respiratory infections, gastrointestinal infection, ear infections)?

Analytic Sample from the ECLS-B

- *N* = 6450
- Children included in analytic sample :
  - who were between the ages of 8 and 10 months at the time of the 9-month data collection
  - who did complete the 2-year child assessment and for whom the parent respondent was the mother at both times
  - with no long-term disabilities
  - missing no information on infant feeding behaviors (the key predictor)

Note: N is rounded to the nearest 50.

Analytic Sample Descriptive Statistics

- Child gender:
  - 49% female
- Child race:
  - 55% White, 14% Black/African American, 24% Hispanic, 3% Asian, 4% Other
- Family poor or near poor:
  - 29% poor or near poor
- Maternal education:
  - 26% $\leq 12^{th}$ grade, 22% HS diploma or equivalent, 27% voc/tech or some college, 26% $\geq$ bachelors degree

Note: normalized W2R0 weight applied

Measures: Infant Feeding Variables

- Feeding behaviors measured: Breast milk, formula, cow's milk, solid/finger food
- Mothers reported the child's age in months when it was first introduced (9-mo PI)
- Variables created for whether the child received each food during the first 6 months of life
- A single measure of early feeding was created for all possible combinations of these four early feeding practices, including each exclusively (16)
- These mutually exclusive categories served as the predictor variables of interest

Measures: Child Physical and Health Outcomes

- Child health status and physical well-being at 2 years

Child Health Variable	M (SD)	Source
Child health rating 2 yrs	1.54 (0.76)	2-yr PI
Child Body Mass Index 2 yrs	17.35 (2.24)	2-yr CA
Ever had asthma	10%	2-yr/9-mo PI
Ever had respiratory infection	21%	2-yr/9-mo PI
Ever had gastrointestinal infection	8%	2-yr/9-mo PI
Ever had ear infection	62%	2-yr/9-mo PI

Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study-Birth Cohort, 2-Year Restricted Data File; normalized W2R0 weight applied.

Control Variables

- Child Characteristics
- Family Demographics
- Child Health Background
- Home Environment
- Mother-Child Relationship

Control Variables

Child Character-istics	Family Demo-graphics	Child Health Background	Home Environment	Mother-Child Relationship
Child race	Maternal ed	Adequacy of prenatal care	Smoking in the house at 9 mo	Mother-child interaction (NCATS)
Multiple birth status	Maternal marital/partner status	Vitamins during first 3 mo of pregnancy	Mother drinks at 9 mo	Maternal depression
Birth weight status	Maternal birth place	Smoked during pregnancy	Non-parental childcare before 6 mo of age	Attachment classification (TAS)
Gender	# children in HH under 18	NICU at birth	Household food secure	Parent knowledge of child development (KIDI)
Age at 2-yr assessment	Maternal employ before 6mo	Child covered by health insurance		Child regulation (ITSC)
	Poor/near poor	Child to bed with a bottle		
	WIC	Well baby check ups		
	Maternal weight			
	Maternal age at 9-mo			
	Maternal health			

Analytic Strategy

1) *What percentage of children were introduced breast milk, infant formula, solid food, finger food, and cow's milk during the first six months of life?*
   - Descriptive statistics
2) *In what combination were these foods most commonly fed in the first six months?*
   - Descriptive statistics
3) *Are the common feeding practices identified in question two associated with child health at 2 years?*
   - Predictor variables were dummy coded; exclusive breastfeeding group served as the reference group for feeding variable
   - Parent-rated child overall health and child BMI were treated as continuous outcomes and analyzed with OLS regression models
   - The four illnesses were analyzed with logistic regression models
   - W2R0 weight applied

Results:

1) What percentage of children were introduced breast milk, infant formula, solid food, finger food, and cow's milk during the first six months of life?

- 70% of mother's initiated breastfeeding and for those whose who did, the mean duration was about 5 months
- Well over half of children are introduced formula and/or solid food in the first 6 months
- 2% of children are given cow's milk in the first 6 months

Variable	First 6 Months	Age in Months First Introduced[a]		Range	
	%	*M*	*SD*	Minimum	Maximum
Breastfeeding	70.4%	5.29[b]	3.47	1	10.9
Formula	76.7%	1.63	1.74	0	10.9
Solid food	75.5%	4.36	1.46	1	10.0
Finger Food	15.7%	6.73	1.41	1	10.9
Cow's milk	.7%	8.13	2.03	0	10.9

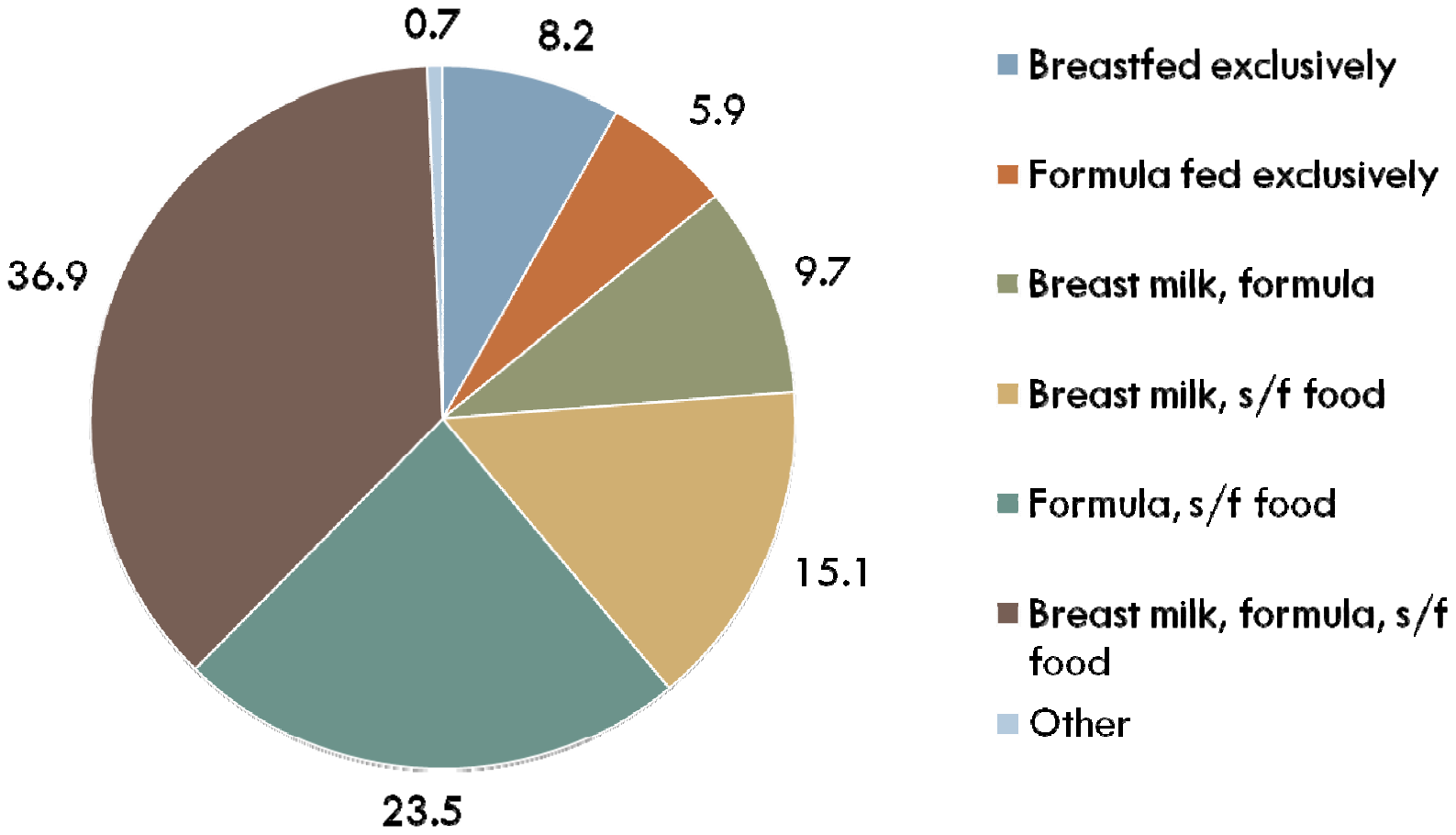
Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study-Birth Cohort, 2-Year Restricted Data File; normalized W2R0 weight applied.

a. Children who had not been introduced the food by the nine month interview were excluded.

b. Only includes those children who were breastfed; represents the mean duration in months

Results:

2) In what combination were these foods most commonly fed in the first six months?



Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study-Birth Cohort, 2-Year Restricted Data File; normalized W2R0 weight applied.

Results:

3) Are the common feeding practices identified in question two associated with child health at 2 years?

- Feeding practice groups were significantly different in terms on BMI, respiratory infections, and ear infections

- Feeding practice groups were no different on overall health rating, asthma, or gastrointestinal infections

OLS Regression with Child Body Mass Index

- The formula and s/f group had significantly higher BMI than the exclusively breast fed group
- The breast milk, formula, and s/f food group also had significantly higher BMI than the exclusively breast fed group

Variable	*B*	*p*	*SE*
Formula fed exclusively	0.37		0.22
Formula and s/f food	0.55	**	0.17
Breast milk and s/f food	0.02		0.17
Breast milk and formula	0.25		0.19
Breast milk, formula, s/f food	0.32	*	0.15
Other	0.25		0.50

Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study-Birth Cohort, 2-Year Restricted Data File.
Note: ***$p<.001$, **$p<.01$, *$p<.05$; W2R0 weight applied; with control variables in model; breastfed exclusively as contrast group.

Logistic Regression with Respiratory Infection

- The exclusively formula fed group had 57% greater odds of having had a respiratory infection than the exclusively breastfed group
- The breast milk, formula, and s/f food group had 46% greater odds of having had a respiratory infection

Variable	*OR*	*p*
Formula fed exclusively	1.57	*
Formula and s/f food	1.40	
Breast milk and s/f food	1.20	
Breast milk and formula	1.02	
Breast milk, formula, s/f food	1.46	*
Other	1.56	

Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study-Birth Cohort, 2-Year Restricted Data File.
Note: ***$p<.001$, **$p<.01$, *$p<.05$; W2R0 weight applied; with control variables in model; breastfed exclusively as contrast group.

Logistic Regression with Ear Infection

- The formula and s/f group had 52% greater odds of having had a ear infection than the exclusively breastfed group
- The breast milk, formula, and s/f food group had 57% greater odds of having had a ear infection than the exclusively breastfed group

Variable	*OR*	*p*
Formula fed exclusively	1.35	
Formula and s/f food	1.52	**
Breast milk and s/f food	1.28	
Breast milk and formula	1.28	
Breast milk, formula, s/f food	1.57	***
Other	0.90	

Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study-Birth Cohort, 2-Year Restricted Data File.
Note: ***$p<.001$, **$p<.01$, *$p<.05$; W2R0 weight applied; with control variables in model; breastfed exclusively as contrast group.

Conclusions

- Many children are being introduced supplementary foods such as solid and finger food before it is recommended by the AAP
- 70% of mothers are initially breastfeeding, 33% were still breastfeeding by 6 months, and 8% were exclusively breastfeeding at 6 months
- 76% of the sample fed outside of the AAP recommendations

Conclusions

- Feeding combinations are associated with child BMI at 2 years
  - Children who were fed formula and s/f food or breast milk, formula and s/f food in the first 6 months of life had significantly higher BMI at 2 years than those who were exclusively breastfed for 6 months
  - The effect size is about .25 of a standard deviation for the formula and s/f food group
  - The effect size is about .14 of a standard deviation for the breast milk, formula and s/f food group
  - Perhaps a link exists between the combination of formula and solid food and higher BMI

Conclusions

- Feeding combinations were associated with child respiratory and ear infections at 2 years
  - Children who were fed formula exclusively and children who were fed breast milk, formula, and s/f food during the first 6 months had greater odds of having had a respiratory infection than children who had been exclusively breast fed for 6 months
  - Children who were fed formula and s/f food or breast milk, formula, and s/f food in the first 6 months of life had greater odds of having had an ear infection than those children who were fed breast milk exclusively for the first 6 months
  - Breastfeeding may provide a protection against particular invasive infections
  - The breast milk, formula, and s/f food group may be particularly vulnerable to infection

Conclusions

- Feeding combinations were not found to be associated with child over-all health, asthma, or gastrointestinal infections at 2 years
  - Previous research has linked breastfeeding initiation to a decreased risk for asthma during childhood before the child was 24 months old, perhaps protective effects diminish over time
  - The link between infant feeding and risk for gastrointestinal infection is stronger in developing countries where risk is higher. In industrialized countries, where the majority of research is conducted with middle class participants, findings have been mixed

Study Limitations

- The study design is correlational in nature
- Early feeding groups may be underestimating the occurrence of mixed feeding behaviors or practices
- The sample was limited to infants who had been assessed between the ages of 8 and 10 months and have data for both the 9-month and the 2-year data collections times. This may have excluded families who were particularly hard to contact and were, therefore, visited when the child was older

Future Directions and Implications

- Interactions between particular foods are also necessary to determine whether there is a link between the combination of s/f food and formula on BMI and infections, and under which circumstances breastfeeding may serve as protective against the early introduction of formula and solid foods
- Exploring BMI as a categorical outcome variable (percentiles)
- An investigation into why many mothers do not follow recommendations is needed
- Family leave policies
- How realistic and how meaningful are AAP recommendations?

Thank you!